DOCUMENT RESUME

ED 362 239 JC 930 463

AUTHOR	Clagett, Craig A.; Huntington, Robin B.
TITLE	Making a Significant Difference with Institutional Research.
INSTITUTION	Maryland Association for Institutional Research.
PUB DATE	93
NOTE	36p.; A revision of "The Institutional Research Practitioner: A Guidebook to Effective Performance"; see ED 320 619.
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Agency Role; College Planning; Community Colleges; Computer Software; Databases; Data Processing; *Educational Researchers; *Institutional Research; Microcomputers; Program Effectiveness; *Research Administration; *Research Coordinating Units; *Research Directors; *Research Tools; Research Utilization; Self Evaluation (Groups); Technological Advancement; Two Year Colleges

ABSTRACT

Focusing on the changing roles of institutional researchers (IRs) due to the widespread distribution of computer technology, this monograph explores the effective application of IR skills to maximize the impact of research on campus policy making. The discussion is centered around three major principles guiding institutional research: know the organization, operate efficiently, and communicate effectively. Following a brief introduction, the first section maintains that IRs must understand both the formal organization and informal networks of communication and power of their institution, as well as its external environment. The second section describes ways in which IRs can operate more efficiently, exploring the proper management of information; keeping up with technological advancements; using personal computers effectively; choosing statistical, database, spreadsheet, graphics, word processing, and desktop publishing software packages appropriately; minimum requirements for computer hardware; possible applications for electronic mail; proper management of people and projects; personal time management techniques; matching tasks to individual techniques; preparing an annual research plan; producing an institutional factbook; creating collaborative projects; increasing office staff; utilizing project-specific employees; and expanding the IR role. The final section examines effective communication, including the creation, use, and misuse of tables and graphs, and choosing an appropriate medium for communicating. Contains 32 references. (MAB)

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Making a Significant Difference with Institutional Research

Craig A. Clagett
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PREFACE

I think, therefore IR.

A core value of institutional research, perhaps the core value, is that information is valuable for decisionmaking. Acknowledging that there are political, organizational, and personal barriers to information utilization, we must, as institutional researchers, believe that information can improve policy choices and college operational efficiency and effectiveness. According to Ewell (1989, p.2),

> the successful application of knowledge requires the simultaneous presence of two conditions. First, the information must have a visible bearing on a perceived problem. Second, there must be a constant and consistent dialogue between those who gather and provide information and those who must use it.

Understanding the context in which information is used is perhaps the most important prerequisite to its effectiveness. In the introduction, we briefly discuss trends changing how and what institutional researchers do. Regardless of how these trends may affect your institution and your role in it, three fundamental principles apply if you are to make a significant difference at your institution: you need to **know your campus** and its needs, **operate efficiently** so as to be able to do policy-relevant analysis, and **communicate your findings effectively** so that they are used in decisionmaking.

This monograph is a revision of our 1990 book, *The Institutional Research Practitioner: A Guidebook to Effective Performance*. This revision was written in response to a request from the Publications Board of the Association for Institutional Research, and has benefited from the suggestions of six anonymous reviewers. Over 1,200 copies of *The Institutional Research Practitioner* have been distributed in the three years since it was first published by the Maryland Association for Institutional Research. Continuing demand justified this update, which we hope will provide useful tips to experienced researchers as well as those new to the profession.

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Introduction

Institutional research is a profession redefining itself. The relative emphasis of the institutional researcher's responsibilities for information collection, analysis, interpretation, and presentation is shifting. While some offices remain limited to the traditional roles characterized by factbook production, external reporting, and providing data in response to ad hoc requests, others are responding to powerful technological and organizational forces that are changing what they do and how they do it.

Evolving technological capabilities and management accountability pressures are shifting the locus of decisionmaking downward in many organizations. Distributed information processing and decentralized decisionmaking authority change the way organizations work, with profound implications for those providing information and analytical support (McLaughlin, et al., 1987). Powerful and easy-to-use desktop workstations, computer networks, and user-friendly software enable staff at all levels of an institution to access and analyze data. As these capabilities become dispersed, institutional research loses the monopoly on information production it once had based on its unique skills and the mystique surrounding computer operations. However, as the number of data users multiplies, new roles for institutional research may emerge. Data administration becomes increasingly important to maintain data integrity and ensure the reliable and accurate use of data (McKinney, et al., 1987). Inconsistent and erroneous interpretations of institutional data can harm both internal management and external reputations. Institutional researchers might become involved in the design of executive information systems, maintenance of system documentation, training of end users in proper data interpretation, and development of institutional data systems.

These new functions do not imply a diminished role in top-level policy support. But to maintain or increase influence, institutional researchers will have to be proactive and assertively reconceptualize their place in executive decisionmaking. The most promising approach involves total immersion in the milieu of top administration: understanding the culture and values of the institution, sharing the vision of its leadership, and supporting and forging the institutional agenda. Implications for institutional research practice include reorienting the research time frame to meet critical decision events, increasing use of qualitative research techniques, linking internal and external data to provide contextual understanding, broadening office expertise into new areas such as institutional advancement,

and emphasizing issue-oriented integration and synthesis of findings from multiple projects rather than detailed presentations focusing on individual studies (Chan and Smith, 1991).

Clearly, the successful institutional research office of the future must do more than provide data and perform number-crunching. Knowledge of the institution and its environment, and the complex predicaments facing top administrators, are essential. As Pace (1990, p.20) reminds us, " 'data' are seldom sufficient for administrative decisionmaking, because the data do not include personalities and politics and history." These latter elements are part of an institution's culture and are of great import. "An organization's culture is reflected in what is done, how it is done, and who is involved in doing it" (Chaffee and Tierney, 1988, p. 7). Knowledge of organizational culture can aid the researcher in many aspects of his or her job, including selection of research projects, research design decisions, and communication and dissemination strategies.

Terenzini's three-tier conception of institutional research as organizational intelligence is instructive (1991). He argues that effective institutional research offices and professionals possess three forms of intelligence:

Technical/analytical intelligence, the fundamental competencies all institutional researchers are presumed to have: familiarity with standard data definitions and formulas, knowledge of database structures and file layouts, skills in research design, sampling, quantitative and qualitative research methods, mainframe and personal computer skills, and oral and written communication skills. Without higher forms of organizational intelligence, however, these number-crunching and report-writing skills are of little value, consisting of "data without information, processes without content, analyses without problems, and answers without questions" (Terenzini, p. 6).

Issues intelligence, an understanding of the substantive problems faced by top management, knowledge of organizational procedures, and general awareness of the political character of organizational decisionmaking. An issues-intelligent researcher knows how the budget process works, for example, and understands the nature of the issues to which his or her analyses will be applied.

Contextual intelligence, an understanding of the culture, values, and customs of an institution and its people. It is a sense of where the institution has been, where it is today, and where it is headed. It includes knowledge of who the key players are and their attitudes and sensitivities. It also encompasses knowledge of the external environments in which the institution must operate. Contextual intelligence is organizational wisdom and savvy that optimizes the effective application of technical competencies and issues awareness to a particular institution and its problems. "It is the form of intelligence that earns institutional research and researchers legitimacy, trust, and respect" (Terenzini, p. 9).

In this monograph, we assume the practitioner possesses technical competencies in research design, data analysis, mainframe and personal computer systems, report writing, and related skills. These should be prerequisites for securing a position in institutional research. Our focus is on how to apply these skills to maximize the impact of institutional research on campus policy making.

Know Your Institution and Its Environment

Our first fundamental principle is that to be effective, institutional researchers must know their institutions and the environments in which they exist. Ewell (1989, p. 2) states that an "overriding lesson of past research on information utilization can be concisely summarized: context is everything." Terenzini stresses that contextual intelligence can only be acquired through on-the-job training. The only exception is the knowledge that can be gained from reading a good history of your institution, should such a resource be available (Terenzini, 1991, p.12.). We would add that reading histories of your primary service area (such as your county or state) is also beneficial for those researchers working in institutions with well-defined markets. However, this literature is no substitute for actual time spent working at an institution, especially if one makes an effort to learn its culture and customs.

Knowing your institution involves much more than knowledge of its formal organizational and governance structures, its rules and procedures. An understanding of the informal networks of communication and power, and the idiosyncratic sensitivities of important players, is even more important. How do you learn such things? While some passive learning will occur with time if you are at all attuned to happenings on campus, you can speed up the process and gain a fuller understanding by deliberately seeking out regular contact with key opinion leaders in the faculty and staff. Have lunch with a variety of such people, involve them in research design meetings, welcome and encourage invitations to visit and informally share research findings. Engage long-time employees in "on-going conversations about what the institution was and is becoming" (Terenzini, 1991, p. 13). For some researchers, who may by nature be on the introverted side, such activities may require some effort. But if you are to maximize your influence on an institution, it is effort well rewarded. Of course, being in the key decisionmaking group in the formal organizational structure helps. Those who sit on the president's cabinet, or are regular members of collegewide planning councils, for example, are in a better position to pick up on the personal and political aspects of the decision process than those who must rely on second-hand versions of events. Those on the outside have little choice but to develop informal sources; however, those on the inside will still benefit from broadening their reach to include the informal channels. We cannot overstate the importance of knowing your institution. If your research is to have what Heacock (1993) calls "organizational validity," knowledge of campus politics and culture is essential.

Institutional researchers can employ some of their research tools to gain contextual information for both institutional and personal use. Explicit studies of the college or university's culture (its underlying values and beliefs as embodied in its history and leadership) and climate (encompassing the resulting attitudes and behaviors) are becoming more common. In addition to surveys, such studies often utilize qualitative research techniques such as focus groups. Climate studies are difficult to accomplish, but a body of literature is evolving that can assist the novice in this area (see Tierney, 1990).

To gain a richer understanding of the institution's external environment, researchers might consider conducting a formal environmental scan (for an overview, see Callan, 1986). A formal assessment of the demographic, economic, legal-political, organizational-competitive, socio-cultural, and technological contexts in which your institution operates can assist in strategic planning, unit operational planning, marketing, accreditation, fund raising, proposal writing, lobbying, and public relations. While committee approaches to conducting scans are often advocated, they are time-consuming and expensive to administer. Institutional research can provide less costly but useful environmental scanning by utilizing existing source materials and actively disseminating the results (Clagett, 1989). To be most useful, the results from the scan of the external environment should be integrated with an internal situation analysis (including climate studies) so that policies are considered in context of the interaction of internal and environmental factors. This, of course, is how strategic planning is supposed to work. The point here, however, is that the institutional researcher can gain important insights into how to conduct his or her activity by participating in these formal assessment activities.

Finally, an understanding of the context of higher education in general is greatly enhanced by involvement in regional and national organizations, such as AIR and the Society for College and University Planning, as well as by keeping current with educational research publications and "The Chronicle of Higher Education."

Operate Efficiently

Our second fundamental principle is that to be able to effectively influence decisions institutional researchers must operate efficiently. The connection between efficiency and effectiveness may not be self evident. Certainly, operating efficiently is not a sufficient condition for ensuring influence. But we argue that it is a necessary one in most cases. This is because internal and external demands for data reporting can easily preclude time for context-rich, issue-focused research efforts. In short, workload can overwhelm resources. Indeed, a national survey of institutional research directors found that "insufficient staff" was the number one obstacle to institutional research effectiveness in influencing policy decisions (Huntington and Clagett, 1991).

Managing Information

Among other things, surviving a condition of inadequate staffing requires good information management techniques. For example, the variety of resources and data files used in an institutional research office necessitates good habits in documentation. As anyone who has ever walked into a job where documentation of files and sources was spotty will know, detailed and thorough descriptions of the data are absolutely essential. Documentation of programs and applications run against the data for standard reports, special projects, and even ad hoc requests are likewise critical. Even if you never expect someone else to need to decipher your work, the main beneficiary of good documentation is yourself! Notes may be kept in a special notebook, along with paper report files, electronically with the data, or anywhere they can be easily accessed. The time required to document your work is well spent, often more than making up for the time it would take to try to recreate such information after the fact, particularly months or even years later.

The partner of good documentation is good organization. Data files, computer programs, reports, and documentation should be stored logically, and that organization adhered to. We have all felt the frustration of trying to find something in a hurry when we have not tidied up our work — the same is true of electronic work. Electronic tidiness can be accomplished by the use of sub-directories and file-naming standards. Data may be organized by types (data on faculty, students, degrees), time frames (fiscal year, fall, end of semester freezes), projects (alumni survey, cost containment), cohorts (fall '86 new freshmen, AY89 new transfers), or a combination of these or other groupings. Most research offices have an or-

ganizational framework already, but it is valuable to periodically evaluate whether the existing framework serves its purpose, whether it is meaningful for the people who must use it, and whether it improves or hinders the efficiency of the office.

Most institutional research offices will benefit from the construction of longitudinal cohort files or tracking systems. These ways of organizing data are particularly useful for enrollment management and outcomes analysis. Standard transcript files and frozen term files are not ideal for these studies. Transcript files contain elements that are periodically updated, with old values usually written over and lost. Term files are often archived off-line and pulling selected elements from several such files can involve extensive programming and media manipulation. Free-standing tracking files for selected cohorts preserve key data values and facilitate data analysis. The data elements typically included in such cohort files fall into three broad categories. First are student attributes such as demographic and academic background variables usually collected as part of the application process. Next are student progress variables recorded each term, such as credit hours attempted and earned and term grade point average. Finally are outcome measures such as employment and further education indicators. Survey data may be included, or maintained in separate files easily linked to the cohort files by student identification numbers. Because maintaining numerous cohort files simultaneously is complex, and because there is usually little variation in successive years (unless substantial changes in institutional policies or student characteristics have occurred), it is generally sufficient to track cohorts entering every third year. Most institutions will only track cohorts entering in fall terms, though spring or summer entrants if substantial in number or notably different in characteristics may warrant separate tracking. Students should be tracked at least six years to allow time for part-time students and stop-outs whose attendance is interrupted to graduate.

Exploiting Technology

The national survey cited above also asked institutional research directors about the specific kinds of "innovations, procedures, techniques, or tools" that have helped to improve research office effectiveness and productivity (Huntington and Clagett, 1991). The top five response categories to this question dealt with computer technology. This section presents an overview of the kinds of technology and software useful in institutional research. Since the worlds of hardware and software are constantly changing, specific products are not mentioned. Established products are frequently updated and new products become available at a bewildering rate. One should be prepared to do a lot of investigating and shopping before making a purchase.

The Personal Computing Revolution

Microcomputers, or personal computers (PC's), have revolutionized office operations, producing the greatest increase in productivity in recent memory. Their near indispensability is reflected in the fact that it is now common to walk into a research office and see a PC on every desk. Today, the PC can do many things a mainframe can do, with the advantage of operating independently of the mainframe system.

As the enhancement of microcomputer technology continues, the segmentation between tasks performed on the mainframe computer and tasks performed on the PC that used to exist is becoming blurred. The difference between mainframes and micros is becoming less significant as PC's become ever more powerful, applications for the mainframe and PC become more similar, the ability to move files between the mainframe and PC (uploading and downloading) becomes easier, and Local Area Networks (LAN's) become more common.

In a LAN, a group of PC's are physically connected by hardware and software, and may have one PC acting as a "server." The users in the LAN may access data files and applications from the server and use the files on their own PC. Thus file-sharing is possible, as with mainframes, and the PC applications are available as well. Furthermore, a link to the mainframe may also exist, allowing for file exchange outside of the LAN. This kind of "inter-connectivity" greatly expands the flexibility and power of the research office, and is becoming increasingly common.

If the administrative staff can be networked, a statistical database can be established complete with a query-language interface so that decisionmakers can access basic data themselves, further reducing the routine data requests made to institutional research. Matross (1987) argues for targeted reporting systems that not only feature data accessibility and easy-to-use software but also "protect users from making unknowing definitional and analytical mistakes" (p. 5). In the case of decision support systems, one way to do this is to provide a summary database of official statistics on-line for use by administrators. Rather than having direct access to the original databases of individual records, the decisionmakers access a much smaller set of official data reflecting the adjustments made for federal and state reporting; that way, their inquiries will not produce figures at odds with those externally reported. In addition, preprogrammed reports, accessible by menu choices, can be constructed to answer standard, recurring administrative questions. These serve the needs of occasional users who may not use the system enough to become adept at creating reports on their own, and who almost certainly will not have a full understanding of the complexities inherent in the use of selected data elements.

Software

Statistical packages are available for both the mainframe and personal computers. Although with large data files mainframe packages may be more efficient, increasingly analysis is being done on PCs with downloaded mainframe data sets.These analytical packages may perform everything from simple descriptive statistics, such as frequency distributions, means and medians, to more sophisticated analyses, such as multiple regression, MANOVA, and discriminant and factor analyses. Factors to consider in selecting a statistical package include data management needs, data interchange capabilities, frequency of use, ease of use, documentation and support, available computer resources, the range of statistical procedures included, operational efficiency, and cost (Yancey and Ruddock, 1987). Before purchasing new software, one should carefully assess each of these factors.

Some of the most widely-used statistical packages have both mainframe and personal computer versions. The PC versions of the packages are generally menu-driven, or at least have the option, greatly reducing the learning curve. While the mainframe packages are

more likely to be command-driven, attempts are being made in their later versions to make them more interactive and user-friendly. These packages, even when menu-driven, generally take some time to learn to use. In any case, a statistical software package is an essential tool for the institutional researcher.

In addition to a powerful statistical package, institutional researchers benefit from a variety of microcomputer software including data management, spreadsheet, graphics, communications, mapping, word processing, and desktop publishing packages.

In situations where the institutional researcher must enter or store raw data, a microcomputer database management package is valuable. Just as an information system on a mainframe computer system stores, defines interrelationships between, and retrieves data, a database application for the PC allows data to be stored, retrieved, and manipulated, with elements and their relationships pre-defined.

The entry and storage of survey response data is a popular use for database packages in institutional research. Many of these packages have features which allow for the creation of data-entry screens. With the data-entry screen raw data may be entered onto the computer by tabbing between fields on the screen that identify the variables. To facilitate entry of survey data, the data-entry screen can be constructed to look like the survey questionnaire, and each field can be defined to only allow entry of valid responses, i.e., entries outside of the choice set will not be accepted. This greatly reduces the incidence of data entry keying errors.

An important feature of the database packages is their ability to upload and download files. Selected data from the database package may be extracted into a file which can be imported into a spreadsheet application or statistical package for further manipulation or analysis. Likewise, data from other sources (a mainframe tape file, a spreadsheet, etc.) can be imported into the micro database package.

Database packages can be somewhat complicated to use compared to other micro applications; however, newer releases are often menu-driven, facilitating use by non-programmers. These packages tend to take up a lot of space on your hard disk, so you should carefully consider your needs and resources before purchase.

Spreadsheet applications are probably the most common type of PC package used in institutional research. Spreadsheets are similar to financial ledger sheets, ruled into rows and columns. The rows and columns form cells into which a number, formula, or label may be stored. Spreadsheets are useful for storing and manipulating small data sets, performing some simple descriptive statistics, and presenting data in tabular form. Most also have some graphic capabilities. Data manipulation may involve physical movement (adding, deleting, or moving columns or rows of data) and performing mathematical operations.

The power of the spreadsheet applications comes from the use of mathematical formulas. The formula referring to one set of cell entries may be copied so that it applies to another set. Very elaborate models may be constructed in this way, making spreadsheets ideal for "what-if" investigations. Model assumptions can be varied and the impact on

various dependent variables immediately discerned. For example, spreadsheets are often used for enrollment projections and financial planning models.

The integrated graphics capability of most spreadsheets is useful during analysis. Generally, line, bar, X-Y, pie, area, and high-low graphs are available. Viewing these while you work with the data in the spreadsheet can highlight relationships and suggest further analysis. Some spreadsheet packages offer high quality, flexible graphics useful for presentation purposes as well.

If more refined graphics are desired for final documents and presentations, a more sophisticated graphics package may be warranted. With dedicated graphics packages, data manipulations are limited, but the graphics are more powerful and versatile, allowing for more text, labels, symbols, font choices, graph types, and overall design flexibility. Some packages come with a "gallery" of clip-art images that can be used as pictures or as backgrounds to enhance presentation graphics. Perhaps more importantly, the final product is generally of a higher quality than with some of the spreadsheet graphics, although the newer spreadsheet releases are closing this gap.

Many of the menu-driven presentation graphics packages are very easy to use and, as with the statistical analysis packages, present a potential danger to the unsophisticated user. Knowing when a graph should be used, deciding what type of graph is appropriate, and creating graphs that do not distort the data, are learned skills.

When geographic analysis is important, a special type of graphics package is called for. Mapping or geographic information system software enable the institutional researcher to display a variety of data by census tract, zip code, minor civil divisions, districts, counties, states, nations, or other geographic units, depending of the cartographic boundary files available. Editors allow the user to define other boundaries as well. U.S. Census and other data associated with geographic units are available on diskettes, enabling the user to easily display demographic variations by geographic location, to support an environmental scanning analysis, for example. The institutional researcher can also create maps of college-generated data. For example, a college might map its enrollment yield rates by state or zip code to help target marketing efforts, suggest transportation needs, or identify sites for extension operations.

Word processing packages made typewriters obsolete by greatly facilitating the writing, manipulation, and storage of text. Newer releases of the more popular word processing packages include some desktop publishing features, and can import tables and graphics from spreadsheets and other packages.

A desktop publishing package picks up where most word processors leave off, by providing a much greater range of text enhancement, type composition, and page layout capabilities. Typeset-quality documents can be produced without the traditional method of pasting up galleys and artwork on a mechanical layout. Pictures and drawings from graphics programs and image scanners can be added, as can tables from spreadsheets and databases. Text and graphics can be composed interactively on the screen and viewed before you print them. Stylesheets can be saved for newsletters and other documents that

you plan to issue more than once, so the design need be created only once. For example, once you decide on a "look" for a research brief, you need only load your word-processing file into the publisher and the previously saved stylesheet file instructs the publisher how to format the document. Just as presentation graphics packages generally have very limited spreadsheet capabilities, desktop publishing packages are generally not word processors, though some text manipulation is possible. Usually, a word-processing document is edited and proofed before loading it into the publisher.

Desktop publishing applications in institutional research might be limited to reports prepared for very special audiences (governing boards, legislators) or for producing survey questionnaires. Desktop packages allow you to create very polished and professional-looking products, which will catch the eye of the audience and reflect well on the institution. Because of the increasing sophistication of word processing software, however, a separate desktop publishing package may be considered more a luxury than a necessity for the institutional researcher.

Common to many types of software packages is the use of automated command sequences called macros. A macro is a sequence of recorded keystrokes or commands that the software executes automatically. Macros are stored with the spreadsheet or document in which they are created, so you can have different macros for each file. Sophisticated use of macros enables construction of applications that can be used by others with very little knowledge of the parent program.

An important consideration when evaluating a software application for your office is its data interchange capability, or ability to read, write, and transfer data stored in a variety of formats from other sources. This is an essential feature for maximizing the usefulness of microcomputer applications software. Data transfer between micro packages is improving as new releases of popular applications are issued. For example, later versions of popular spreadsheet programs provide full access to popular database package files from within the spreadsheet without having to convert the database files to worksheet files. All of your software packages should have interface capability.

In deciding which kinds of software you need and which particular packages you want, one of the most important resources to take advantage of is colleagues in other research offices. Find out what packages others are currently using, how well they are doing the job, and how difficult they were to learn. Also, speak with the people in your institution's computing offices. Finally, visit your library, a bookstore or newsstand. There are many magazines aimed at the PC user, as well as numerous books, manuals, and guides.

Particular attention should be given to how difficult packages are to learn. Assessing the learning curve is important in making decisions to upgrade to a new version of an existing package, as well as in initial purchases. While applications software revolutionized institutional research, providing the greatest single leap in office productivity in institutional research's short history, researchers must avoid becoming captive to an obsession with the latest, state-of-the-art tools. You can easily devote excessive office time to evaluating new software and discovering bugs in the newest releases. In reaching decisions to adopt a new package or upgrade an existing one, the impact on office productivity should be carefully

considered. In general, such transitions should be made only when the new product offers improvements that will have a substantial return on office efficiency. However, once you adopt new packages and become accustomed to each new feature of these valuable and evolving tools, you won't know how you got along without them!

Hardware

A detailed discussion of computer equipment is outside the scope of this essay. A few general suggestions follow.

Two of the most important features to consider when purchasing a PC are storage and memory. (Of course there are many other important features which should inform your decision.) If you think of a PC as a work-desk, storage is the amount of room in the desk to keep things, and memory is the amount of room you have on top to work. You will need a system with a hard drive (storage) large enough to store the kinds of applications you plan to use. Storage requirements vary from package to package, and should be considered when purchasing both a system and the software. Memory is the next consideration, as some of the more sophisticated packages take a lot of memory, or need a lot of room "on top of the desk," to run. Generally, buy the most memory and storage you can afford. As of this writing, 8MB of RAM and a 200MB hard disk are our minimum recommendations.

You will need access to a printer. Today, laser printers are the standard. There is little point in having some of the top-of-the-line graphics packages or desktop publishers if you don't have a printer that can take advantage of them. Ink-jet printers are a less expensive alternative. A multi-pen color plotter or slide generator is useful for producing presentation overheads or slides. You might also create slide shows from you graphic package for presentation on a monitor or with projection technology.

Another useful peripheral to have is a modem or data-line. A modem allows you to connect your PC to other computer systems through telephone lines. You could have direct communications to on-line library catalogues, national databases, or communication networks. These kinds of connections to the outside world vastly expand the usefulness of your investment in technology. Indeed, "the question is not whether the computer network will be the single most important technological event of the century for higher education, but rather how it will occur" (Ferrante, et al., 1988). Institutional researchers that lag behind in partaking in the electronic revolution will incur a disadvantage that will become more apparent as time passes.

Electronic Mail

Electronic mail, or "e-mail", has been changing the way many offices do business. Many people are familiar with e-mail through networks on their institutions' mainframes with which they communicate with others in the institution. Some of these e-mail packages are sophisticated menu-driven packages that have all but replaced paper memoranda in institutions which use them. The advantage of this kind of e-mail is that, unlike sending memos through campus mail, e-mail is almost instantaneous. It allows for electronic responding and record-keeping and it eliminates telephone tag. Some people will even send an e-mail

memo to a person sitting in the next office for non-urgent matters, thereby avoiding interruptions and allowing the recipient to respond at their leisure. The disadvantage, of course, is that necessary face-to-face or "real-time" discussions may be avoided or the e-mail recipient may simply ignore the message. The same problems are true of paper memoranda. The biggest breakdown occurs when someone doesn't use the system regularly, possibly missing important messages.

Where the power of electronic mail becomes significant for researchers is in communications with others outside of one's institution. Most larger colleges and universities, and increasingly now, smaller colleges, have access to networks which connect mainframe computers across the country and around the world. Using these communication networks, individuals in different locations can share information, electronic files, data, reports, documents, etc. almost instantaneously. The largest networks include BITNET and CSNET (now merged as CREN) and Internet, which is actually several interconnected networks (Updegrove, Muffo, and Dunn, 1990).

What makes electronic communication such a valuable tool to institutional research professionals is the speed and ease with which research and decisionmaking may be informed by information outside of one's own institution. Qualitative and anecdotal as well as numerical information may acquired through requests made electronically (Dunn, 1989). However, as Dunn points out,

> multiplication of data access intensifies the problem of assuring the validity of the data. When everyone can and does contact his or her colleagues to find out what is going on elsewhere, it is not surprising that what emerges is not a single clear story but multiple, possibly confusing stories. (p. 81)

To avoid this problem, frame each inquiry precisely, asking for only the essential data elements and providing specific definitions. Rather than a shotgun approach, develop a set of peer institutions on the network and direct your specific data questions only to them. Follow Dunn's advice to "provide data to others as you would have them provide data to you," to encourage reciprocity and network usage (p. 82).

Aside from communicating with known colleagues for specific data, one can take advantage of a variety of vehicles for more general information gathering and sharing. There are edited electronic "newsletters," such as the ones associated with AIR and SCUP, which report on news useful to their membership, post job listings, and contain requests for advice and other submissions by subscribers. A "discussion list" may be more free-form, with comments, suggestions, questions, and responses from subscribers shared in an open forum. There are discussion lists for practically any interest group imaginable, including such relevant topics as community college education, executive information systems, and almost every academic discipline. Also, data-sharing groups, such as HEDS, are moving towards electronic data exchange.

Computer technology has changed the institutional research office dramatically over the last few years, and will continue to do so. Although it may be difficult to keep up with the brisk changes in computers and software, having the right tools for the job at hand is as important as ever.

Managing People and Projects

Most offices of institutional research could profitably use additional staff. However, before you can legitimately and persuasively argue the case for more staffing, you must demonstrate that you are effectively using the resources at hand. In addition to using technology well, office efficiency can be increased by employing an assortment of management tools to get the most out of your staff.

Personal Time Management Techniques

While we argue that the institutional research director can become a major player in campus decisionmaking, the function he or she oversees will retain a service orientation. Responding to requests for information and analysis is a central office function. Institutional researchers face the same problem as other busy professionals: making the most effective use of limited time. Personal time management techniques can provide some guidance. Ask yourself four questions:

1. What will happen if I don't do this at all?

The first question is the basic yes/no, to do the job or not. A respected research office will get more requests than it can possibly handle and so will by necessity have to turn some down. If the request is clearly not an institutional priority but rather reflects a more narrow interest, and your overall workload precludes attention to it for an extended period, be honest with the requesting party. Suggest how the need might be met elsewhere. If the request can wait, add it to the office project queue and periodically inform the requesting party of its status. But for those requests that have such a low priority that it is unrealistic to expect action in the foreseeable future, it is better to practice project triage so you can devote adequate time to the more important ones.

2. Is there someone else who can do this well enough?

It is important to maintain quality control and ensure accurate data support to top management, but an overextended institutional research professional cannot do it all. If a project is worth doing but your personal time is committed to other, higher priority projects, delegate the work to someone who can do an acceptable job. In a large office of highly skilled professionals, this may simply be a matter of job assignments among research staff. In smaller offices, delegation means trusting someone outside your office and may therefore be more problematic; you have built your professional reputation and office credibility on your own efforts and delegation may mean a

job done differently than you would have done it. But if you maintain sufficient oversight you can get the work done in a satisfactory if not optimal manner.

3. How much time is this task worth?

Analytical pathways can be unending, as each new insight can lead to several other areas to explore. Bringing really interesting research projects to closure requires discipline; usually, however, the pressure of other tasks makes the effort easier. (An important question raised by current research can be designated a separate follow-up project.) It is helpful to set limits at the outset and stick to a timetable for project completion—an office project management system can help.

4. Is this the best use of my time now?

Once you know what projects you should personally work on, and have established limits by defining the project parameters, you still need to decide what task should demand your attention now. Prioritize your tasks according to deadline and importance. Don't procrastinate on the important projects by doing the easy ones first; if you do, you'll end up doing the really visible and important work in a rush—not an effective approach.

Matching Tasks to Individual Strengths

As soon as the office grows beyond one person, the importance of matching job assignments with the specific skills of individual employees surfaces. This means more than simply allocating work according to established job descriptions. People differ in how they acquire information, how they reach decisions, how they prefer to interact with others. Awareness of preferred work styles may aid in producing more effective task assignments. Giving work assignments that people enjoy can improve morale, productivity, and work quality. However, care must be taken that specialization and division of labor do not create indispensable employees whose absence would totally halt work flow. It is important that office staff be cross-trained in all software and systems essential to office functioning. In addition, employees should periodically be given challenging assignments that push them to expand their skills; staff professional development should be an office goal.

Annual Research Plan

Preparation of an annual research plan at the beginning of each fiscal year serves several useful purposes. Planned activities can be posted under three headings: required external reporting, routine institutional reporting, and priority research projects. Use a matrix, with these three headings as columns (plus a fourth column for estimated staff hours needed) and calendar months as the rows. Using federal and state reporting schedules, post required external reports by due date on the research plan calendar. Next, post all anticipated, recurring institutional reports by month in the second column. Post the estimated work hours, classified as director/analyst/technician level, in the fourth column for all external and

routine internal reports entered. The calendar will now suggest what months have time available for priority research projects, and approximately how much staff time is available. Use this information in discussions with your president and other top administrators; by showing that the time available for substantial research efforts is limited, you can make the selection of priority projects a visible choice—highlighting the fact that perhaps many meritorious projects cannot be done given current resources. You also gain consensus that the projects you do accept are those of greatest importance to the institution. Post the agreed-upon priority projects by month in the third column to complete your annual research plan.

In addition to using the annual research plan as a negotiating and educational tool with top management, you can elaborate upon it for office planning purposes. Office goals and objectives for the year can be developed concurrently, and all posted reports and projects can be entered into an office project management system for monitoring productivity throughout the year.

Office Project Management Systems

Keeping track of the multitude of projects underway concurrently in most institutional research shops is greatly facilitated by implementation of an office project management system. A busy shop may complete over 100 projects annually, most with established due dates and many containing multiple stages. Even a one-person shop can benefit from a computerized system for monitoring project progress, while such a system is especially valuable to larger offices. You do not, however, need specific project management software. Such software is intended and most appropriate for large, long-term projects with many interrelated subunits, where time and cost monitoring are essential. The need in the typical institutional research office is different. Rather than detailed tracking of one or a few individual projects, the need is for monitoring the status of dozens of projects with near-term due dates. It is easy to set up an effective project management system on the office's microcomputer database software. The following data elements might be considered the minimum necessary: project number, requested by, date of request, date needed, project name, project leader, priority, status, date begun, and date completed. Reports generated from the system might include project status report by due date, monthly report, project leader status reports, and project lists by number and alphabetically by name. Others can be created as needed, such as an annual report at year's end. The status reports can be used at periodic staff meetings to track project progress and staff performance.

Institutional Factbook

While laborious and time-consuming to assemble the first time, the traditional institutional factbook has proven to be an effective way to reduce the numerous requests for straightforward data that frequently interrupt your daily work, and it provides the college a common reference so people will use the same numbers in policy discussions on campus. While electronic networks are providing new ways to share data efficiently, the printed factbook remains a useful product. The paper version is portable, and accessible to those who are not computer users. With wide distribution of a factbook, one hopes that grant proposals, committee discussions, budget briefings, external reports, college publications,

and other settings where data are used will report consistent numbers even when the preparers don't contact the institutional research office. In designing a factbook, several factors, including the audience, timing, type and level of data, and means of presentation, as well as the purposes of historical record, public relations, and decision support, should be considered. (Nichols, et al., 1987.)

Collaborative Projects

Collaborative projects conducted with state agencies and professional organizations can bring large returns on small investments. Colleges, through participation in systemwide data collection efforts, perhaps with the involvement of a state coordinating board, can contribute to the creation of systemwide data files permitting cost-efficient data analysis. One analyst can program and run statistical analyses of the data, with results produced for each participating college, selected peers, and systemwide averages. In addition to enrollment, graduation, employee, and cost files, surveys of entering classes, graduates, employers, and other groups can be conducted using common questionnaires, yielding other systemwide data sets for analysis. Collaborative projects can sometimes garner outside funding support, expanding the cost savings. If your state does not have a statewide institutional research organization, consider starting one. The economies of scale and shared expertise can contribute greatly to individual office productivity.

Increasing Office Staff

Making the most of available resources is a necessity for today's busy institutional researcher. It is hoped that the personal time management principles, management tools, and technological aids recommended here will enhance the productivity of institutional research, enabling it to gain the time needed to conduct meaningful policy analysis as well as meet increasing demands for data. However, office workloads may be such that merely operating at optimum efficiency is insufficient. Casual conversations, personal observations, and formal surveys (e.g., Huntington and Clagett, 1991) suggest that many institutional research offices are inadequately staffed. Offices limited to simple data reporting and descriptive analysis due to inadequate staffing are not fulfilling the potential of institutional research to positively influence institutional decisionmaking. The following discussion highlights several strategies for increasing institutional research staffing.

Hire Temporary and Project-specific Employees

If adding permanent office personnel is not on the immediate horizon, attempt to obtain budget dollars for consultant services. Even small amounts are worth pursuing; in addition to accomplishing specific tasks, establishing the budget line may be the first step to a new position. Use the consultant budget for high visibility projects and try to increase it yearly. The larger it grows, the less the financial jump to funding a staff position.

An alternative to hiring outside consultants is to use college faculty on released time. Faculty in the natural and social sciences, mathematics, business, and other departments may have the skills and the inclination to apply them to institutional research needs. Faculty research associates may be used to complete projects on an intermittent basis, as projects arise

that fail to make the priority list but attract faculty interest, or may be routinely assigned to the office. The cost to the college is reasonable, usually the cost of hiring part-time adjunct faculty to cover the research associate's course load. Depending on the project, the faculty member may be released from teaching for an entire semester, or just one or two courses.

Institutional researchers have experienced varying levels of satisfaction with faculty associates. While some arrangements have worked out well for all concerned, others have had problems. Some faculty approach institutional research staff as personal research assistants rather than colleagues, are focused on their personal rather than institutional needs, and are unconcerned with deadlines. The institutional research director needs to be alert to these possibilities. At a minimum, he or she should have final approval over both the specifications of the project and the appointment of the faculty research associate.

Substantial staff help may be obtained through grant-funded research positions. For example, colleges that qualify for Title III institutional strengthening grants may be able to develop activities with substantial research components justifying funding of new positions. Depending on the activity, even full-time research positions may be funded for periods as long as 3 to 5 years.

Do not rule out innovative solutions just because they are not common practice. For example, your institution might be willing to fund one or two permanent half-time positions (without benefit costs) rather than a new full-time position. With good planning, hiring decisions, and task assignments, this can be an effective alternative to increasing the full-time staff.

If new positions, either on the operating budget or funded in other ways, are not foreseeable, another option is altering the job descriptions of existing positions. For example, microcomputing has eliminated much of the traditional function of the office secretary. No longer needed to type and proof statistical tables and draft after draft of research reports, since these are now done by the originating analyst using spreadsheet, database, and word processing software, the traditional role is largely obsolescent. Consider changing the secretarial job description. While this new position might continue main office phone coverage, and monitor the office budget and payroll function, the majority of its responsibilities would involve research tasks including data entry and tabulation, administration of surveys, preparation of graphics, and elementary statistical analysis. Train an existing secretary to do these tasks, or, if circumstances permit, create a new research technician position that enables you to recruit based on research and statistical skills.

Seek Out New Opportunities to Contribute

The strategy for increasing staff with the greatest risk is to seek out new opportunities to contribute research and analytical support to top management. Advocating the pursuit of more work as a solution to work overload sounds irrational, but there is a certain logic to it. The idea is to break out some time to provide something new and valuable to people in a position to help you get more staff. Show them how institutional research support can be of value to their immediate concerns, and how this support could be ongoing if institutional research had the necessary staff. Ideally, the new contribution will be highly visible as well as valuable. You will need to be proactive and attuned to what looms on the ad-

ministrative horizon to identify these opportunities. These initiatives will indeed increase the institutional research workload. They also promise to increase office visibility, importance, resources, and staffing. New, strong allies for continued institutional research support may be found, which may prove critical if retrenchment actions should threaten future office budgets or staffing profiles.

To sum up: be valuable and visible. Welcome opportunities to share research findings with campus constituencies in oral presentations. Consider publishing a brief but widely circulated office newsletter. Take the time to document institutional research contributions in your college's annual report. In your own monthly reports, include a sentence or two summarizing the major insights of research studies, rather than just listing them. In short, remind people how valuable the institutional research function is by making your contributions visible. If you're lucky, and do your job well, staffing just might take care of itself. If not, you will need to actively seek the new positions you need.

Annual budget requests should include staffing requests backed up by a detailed justification statement. Explain how existing resources are being used productively, and describe specific projects—beyond current office capabilities—that could be accomplished with the added staff member. If you have a temporary position producing valuable output, make the case for funding the position on the operating budget to ensure continuation of its contribution. If you cannot write a persuasive justification, you shouldn't be seeking the position.

The timing and frequency of staffing requests need to be carefully considered. Every new request for service should not be responded to with an inadequate staffing refrain. Keep a record of unmet requests of obvious merit (use your project management system); this can be a source for your annual justification statement. Do not be discouraged if your position is turned down but be persistent in its advocacy. Build an alliance of project seekers who will support your request at the opportune time.

Communicate Effectively

Knowing what information is needed, and operating efficiently enough to produce it, are necessary but not sufficient conditions for making policy-relevant contributions to your institution. Policymakers must have your information in mind when they are reaching decisions. Thus our third fundamental principle is that to have optimal impact, you must communicate your findings effectively. Transforming data into useful information is both an art and a science.

In part, the challenge is to present research results in formats and at a level of sophistication accessible to top management. Few top administrators can afford the luxury of studying in detail the numerous statistical reports generated by a productive institutional research office. Only a few findings have the chance to influence institutional decisions. The research professional must devise ways of improving the odds that study insights will be assimilated into the decisionmakers' frame of reference.

The most promising place to start is to provide the decisionmakers with the data they need. As discussed earlier in this monograph, the institutional research director should be "in the loop", preferably on the president's cabinet, college planning council, or equivalent. If this isn't possible, ensure through other means that you are kept informed so that project priorities and research designs are chosen to maximize their utility to decisionmakers. Note that this means more than being responsive to requests; decisionmakers may not know enough to ask for data that may be useful to them. The effectiveness of, and respect given, institutional research increases when it provides information unasked for but pertinent to the task at hand.

The timing of your communication of information is critical. Your analysis won't have much influence on a decision that was made yesterday. It's best to be proactive and have the information prepared before it's needed, and then time its presentation to coincide with the beginning of deliberations of decisionmakers. However, since it's impossible to anticipate all decisionmakers' needs, maintaining a readily-accessible database for quick responses to late-breaking requests is also necessary. This would include an office library of reference materials as well as computer access to student and other files.

You should attempt to match the format of your communications to the level of analytical sophistication and learning preferences of recipients. As Meredith (1989) has argued, "Use the least sophisticated tool to make your case. Don't get wrapped up in procedures when results and trends are the most important product." Presidents and trustees may not accept your findings if they get overwhelmed by your statistical wizardry. While you must employ the most appropriate tool based on your judgment as a research professional, you must also present the findings in ways accessible to your audience. If you lose people in long discussions of your methodology, the valuable insights you may have discovered may be lost as well.

It's a good idea to focus on one or two research questions in a given communication. While particularly applicable to oral presentations, this is a good guideline for written reports as well. A series of brief reports, each devoted to one or two issues, will often be more effective than one large, comprehensive study. To avoid confusing your audience, keep your language as simple and direct as possible. You may have no choice but to use sophisticated, even arcane, techniques, if the task calls for them, but you need to discuss them and their results in common terms. For most applications, you will want to avoid the jargon of your discipline. Reread your Strunk and White, and remember Thomas Jefferson's words: "The most valuable of all talents is that of never using two words when one will do."

Graphics can help communication, but they must be used with discrimination and precision. The ease of graphing provided by microcomputer software has caused the proliferation of graphs in institutional research applications, often compounding the problem of information overload and reducing the effectiveness of communication. The untutored can easily create misleading graphics, and even the skilled often use too many of them.

You might consider the infrequent use of analogies, mnemonics, or other verbal aids. While a reputation for excessive cuteness will ruin credibility, the occasional use of catchy phrases can be effective. For example, "it takes two 40-year-olds to equal one 18-year-old" will get laughs but also make the point that FTEs will fall with a one-to-one replacement of declining high school graduates with older "returning adults." The catchy phrase works where a table of average credit hour loads by age cohort may not.

Strive to repeat major findings in subsequent communications when opportune. The active life of much institutional research in decisionmakers' minds can be very short—an answer to an immediate question is often quickly forgotten. This is unfortunate; the insights of solid research could often continue to be useful guides to decisionmaking. Look for opportunities to restate research findings, especially when they go against the conventional wisdom. Use previous findings when pertinent to new studies and build institutional knowledge. In your monthly activity reports, instead of just listing projects completed, include a sentence or two summarizing what was learned. Through iterative release of information, develop a data dialogue (Ewell, 1989, p. 17) with decisionmakers to keep research findings in their minds and to provide feedback to guide your future research efforts.

Tables or Graphs?

Data may be presented in tables, displayed in graphs, or discussed in text. Tables are best when exact numerical values need to be communicated, and when many localized comparisons are to be made. Graphs can communicate trends powerfully, and reveal relationships in the data that would remain hidden in tables. Text allows for interpretation, and is usually most accessible to broader audiences.

The use of graphs in institutional research has expanded rapidly in the recent past, spurred on by user-friendly software. Despite claims by vendors that the use of computer graphics improves decision speed and quality over traditional methods of data display, the available evidence is more mixed than supportive; indeed, research suggests graphs may be no better than tables as an information presentation method. In a comprehensive review of the literature, including 116 references, DeSanctis (1984) found that features that make a graph visually attractive, such as color, design complexity, and realism, may detract from accurate comprehension. The ability to use graphs effectively varies across individuals, so an overreliance on graphical displays may inhibit understanding and effective communication. Examination of studies directly comparing tables and graphs on several dependent variables, such as interpretation speed and accuracy, information recall, and decision-making confidence, found tables more effective than graphs more often than the reverse (DeSanctis, 1984, p. 475). Her conclusion, that "support for the superiority of graphics over tables as a presentation mode is extremely weak," should give pause to graphics-happy institutional researchers.

Tables will continue to be the most common mode of data display in institutional research because actual data values will continue to be wanted by decisionmakers. Tables are compact and exact but their abstractness requires an educated reader. As MacDonald-Ross (1977) has pointed out, "Even quite sophisticated people need time to get the main points from a table (often much more time than they would need with a bar chart or pictorial chart) and less educated people often cannot read tables at all" (pp. 378-379). Proper table design can ease the difficulty. Adherence to the following principles of tabular design can improve data communication by tables:

1. Have a clear purpose for presenting the data and design the table to make your point.
2. Ensure through adequate labeling, including title, headings, units, and sources, that the table is self-explanatory and can stand alone if removed from its context.
3. Provide row and/or column averages for reference points.
4. Use columns for most important comparisons.
5. Rank order rows and columns by size of numbers, not alphabetical order of labels.
6. Set columns and rows compactly—do not artificially space out to fill the page. Space can be used to distinguish blocks of related data.

7. Round numbers to two significant digits to facilitate mental arithmetic.

The last principle is routinely violated in institutional research reports, but is worthy of consideration. Rounding errors are usually trivial in effect, and the positive advantage of eliminating the extra digits is that "we can see, manipulate, and communicate two-digit numbers better" (MacDonald-Ross, p. 379).

Creating Graphs

Simply because user-friendly software has made creating attractive graphs an easy task does not imply that creating effective graphs is easy. As Schmid and Schmid (1979) state, "no amount of sophistication in computer technology alone is a substitute for genuine understanding and expertise in the theory and practice of graphic presentation" (p. 12). They assert the widespread existence of "graphic illiteracy" (p. 11):

> Although statistical charts are often a more powerful and significant vehicle of communication than words, there is a strange tolerance for poorly constructed charts. Paradoxically, the reader who is outraged by an ungrammatical sentence, an ambiguous statement, or even misplaced punctuation marks may be quite tolerant or indifferent to crudely designed, idiosyncratic, inappropriate, or confusing charts. This situation is essentially reflective of the graphic illiteracy not only of the reader but also of those responsible for the preparation of poorly designed and executed charts.

MacDonald-Ross concurred, saying that "the researcher will soon discover that most practitioners are more or less incompetent!" (p. 403). Incompetence and intentional deception produce graphics that "lie," so Tufte (1983, p. 77) developed six principles of graphical integrity to ensure that graphics tell the truth about the data:

1. The representation of numbers, as physically measured on the surface of the graphic itself, should be directly proportional to the numerical quantities represented.

2. Clear, detailed, and thorough labeling should be used to defeat graphical distortion and ambiguity. Write out explanations of the data on the graphic itself. Label important events in the data.

3. Show data variation, not design variation.

4. In time-series displays of money, deflated and standardized units of monetary measurement are nearly always better than nominal units.

5. The number of information-carrying (variable) dimensions depicted should not exceed the number of dimensions in the data.

6. Graphics must not quote data out of context.

Tufte's book should be read by anyone interested in graphical displays of data, for the enjoyment as well as the enlightenment it provides. In addition to not distorting the data, graphical excellence for Tufte consists of communicating complex, usually multivariate, ideas with clarity, precision, and efficiency, summed up in his principle (p. 51):

> Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.

Tufte's idea, that most of a graphic's ink should vary in response to data variation, underlies his theory of data graphics and leads to some experimental designs that, at the least, would take some getting used to. Until they are included in popular graphics software packages, most institutional researchers will continue to use the traditional formats.

Graph Purposes, Types, and Effectiveness

Graphics for presentation purposes usually have one of the following purposes: to show component proportions, item magnitudes, trends or time series, frequency distributions of items over ranges, or relationships between variables. (Graphics can also be used for analysis; see Anscombe [1973] and Tukey [1977].) While your purpose should determine the type of graph you select, research and experience suggest some types are more effective than others:

Horizontal bar charts. Several authors, including MacDonald-Ross (p. 401) and Zelazny (p. 26), argue that horizontal bars deserve broader usage due to their versatility and effectiveness, especially for showing item comparisons. Deviations, correlations, and the mix of two components can also be shown with horizontal bars using both sides of the vertical axis.

Line and column charts. These are effective, reliable workhorses for showing time series and frequency distributions.

Pie charts. The ubiquitous pie chart is overused. While appropriate for showing composition or component parts of a whole at a single point in time, pies should be used in moderation. Most people have difficulty making fine distinctions between angles; pies with more than four segments are especially problematic. Tufte is emphatic in his distaste for pie charts: "A table is nearly always better than a dumb pie chart; the only worse design than a pie chart is several of them, for then the viewer is asked to compare quantities located in spatial disarray both within and between pies" (p. 178). Multiple pies, and those with more than four slices, are to be avoided, but the infrequent use of individual pies with four or fewer segments can be an acceptable way to add variety to a report or presentation.

Segmented bars and graphs. Segmented or stacked bar graphs attempt to show both magnitude and composition. In certain specific instances, for example when one segment is largely responsible for the overall change in magnitude, segmented forms can be effective. However, because they lose the common reference line and make comparisons difficult among all but the bottom segments, they should generally be avoided. Segmented area graphs are even more difficult to comprehend.

Three-dimensional graphs. While intriguing to look at, three-dimensional graphs contain unnecessary complexity and are often ambiguously perceived. When they vary in more dimensions than the data, three-dimensional graphs are invariably misleading, as they are rarely constructed so that the change in volume is proportional to the change in the data. MacDonald-Ross's review of the literature on visual perception led him to state that "segmented graphs and three-dimensional forms (that represent quantity by volume) should *never* be used" (p. 401).

Chloropleth maps. Chloropleth maps show geographic areas of equal value on the variable investigated by the same color, hatching, or shading. They are useful for geographic analysis, where location is paramount, but they can be misleading since they equate the visual importance of a geographic area with the value of the variable being displayed, or as Tufte puts it, "Our visual impression of the data is entangled with the circumstance of geographic boundaries, shapes, and areas" (p. 20).

Pictorial charts. Pictorial charts use icons or symbols associated with the subject matter to show quantity and are thus less abstract than other charts and more accessible to the general reader. The only acceptable pictorial chart is that which repeats identical symbols of the same size to reflect quantities. Those that change width as well as height to maintain pictorial proportions will distort the data, unless carefully designed to reflect the data change by area, a difficult and infrequent practice. Tufte shows several examples of how the "confounding of design variation with data variation" leads to "ambiguity and deception, for the eye may mix up changes in the design with changes in the data" (p. 61). Huff (1954) and Spear (1969) also point out intended and innocent examples of misleading pictographs. Two-dimensional pictographs of objects generally understood as having three dimensions further compound the distortion; a true doubling of the data in question shown by a picture twice as high may be conveyed visually (since the mind understands the image as three-dimensional) as an increase by a factor of eight. In general, pictorial charts, though popular in the mass media, should not be used in institutional research applications.

Inadvertent and Intentional Graphical Distortions

Selecting the appropriate graphical type is not all there is to proper charting. Misleading graphics may be created on purpose by the clever or unwittingly by the uninformed. The following discussion will illustrate the nature of the problem.

Graphs with arithmetic scales should almost always begin at the zero base line and not have any breaks in order to show the true variation in the data. By showing only a fraction of the scale, through a broken scale or starting at a nonzero origin, data changes may be greatly exaggerated. Clearly marking the scale break is not a sufficient remedy, since what is remembered is the distorted impression, not the broken scale. The only exception is in an analysis of marginal changes, and only if the graph is so labeled and this context is clearly understood by the audience.

By expanding or contracting the horizontal or vertical axis, or both, the graph designer can visually alter the slope of a trend line. Changing the proportion between the ordinate

and the abscissa is a simple way of manipulating the visual impression of data change. The best defense is an educated viewer who takes note of the scaling units.

Beware of charts using two or more scales; it is very easy to adjust the scales to make one trend appear greater in amount or slope and thus more important than another trend. The use of standardized units may obviate this problem, at a cost of adding abstractness to the presentation.

Finally, a word about color. Color may detract from effective communication if used in an unthinking manner. If a chart does not communicate well in black and white, color is not going to help (Zelazny, p. 80). Color should be used for a purpose, not as decoration. For example, color can be used to highlight the key part of a graph, to identify a recurring theme in a series of charts, or to distinguish actual from projected data.

Underlying this discussion of graphical design is a necessary commitment to integrity in data presentation. The institutional researcher usually has much discretion in determining how data are presented, being acknowledged as the expert in this area. Darrell Huff (1954, p. 120) made the point well:

> The fact is that, despite its mathematical base, statistics is as much an art as it is a science. A great many manipulations and even distortions are possible within the bounds of propriety. Often the statistician must choose among methods, a subjective process, and find the one that he will use to represent the facts. In commercial practice he is about as unlikely to select an unfavorable method as a copywriter is to call his sponsor's product flimsy and cheap when he might as well say light and economical.

Proper graph construction is an ethical as well as statistical and artistic exercise. "Visual presentations have a more lasting impression than the data they represent" (Spear, 1969, p. 68). Institutional researchers should strive to "tell the truth about the data" by being aware of potential distortions and by applying Tufte's principles of graphical integrity.

In addition to the selection and proper construction of individual graphs, the mix of graphs used in a report or presentation should be carefully considered. Page after page, slide after slide, of the same graph type should generally be avoided; the monotony can destroy effective communication. (An exception is a short series of similar data displays where trend or profile comparisons across graphs are desired. For related graphs in such a series, use the same format, typestyle, orientation and scale on all graphs, so the viewer's focus is on the data variation and not design variation.) In most applications, the principle that graphs should be used sparingly for emphasis or to reveal relationships holds. When many graphs are to be used, a variety should be used to aid audience attention, if the data and purpose allow. Zelazny (1985, p. 26) recommends a mix of 50 percent column and line graphs, 25 percent horizontal bars, 10 percent dot or scatterplot, 5 percent pie charts, with the remainder combination graphs. This recommended mix varies from common practice, where pies are frequently overused and horizontal bars underused.

Written, Oral, or Electronic Communication?

In addition to decisions about the format of presenting data, in terms of tables, graphs, or text, you must choose the medium: written, oral, or electronic. This choice largely reflects the nature of the request. Offices need a quick response capability to respond to unforeseen inquiries. Institutional research has been defined as "whatever Edgar wants" (Clagett and Huntington, 1990) to suggest the necessary responsiveness and almost unlimited scope of institutional research. As the chief information officer of a college or university, the institutional research professional often is called upon to meet the immediate information needs of the president, governing board, or top policy and planning administrators. Although many of these specific, ad hoc requests cannot be foreseen, the research office can maintain data systems and reference materials facilitating quick and accurate responses. A telephone call, quick memo, or electronic message is often all that is required once the needed information is compiled.

Most substantial research projects will result in written reports. The nature of the report should reflect its purpose and audience (Jones, 1989). Often, short, concise research briefs focused on one or two research questions will be more effective than long, comprehensive treatises when trying to influence busy decisionmakers. The standard format of executive summary, introduction and background, method and limitations, findings, conclusions, and appendices is appropriate for more formal reports, especially if they concern highly visible or controversial policy decisions. Technical appendices may lend credibility and be read by an unseen audience of advisors to top management. The importance of the executive summary cannot be overstated. An executive summary is not only a courtesy to your reader, but may mean the difference between your study being read or not being read. A large report lacking a summary may not be read at all; with an overview up front to spark interest, it may be read in full. At the very least, the reader will learn the major findings from reading the summary.

Strive to integrate tables and graphics into the text. Avoid having page after page of tables or graphs with no text, or data separated from text so that the reader constantly has to interrupt his or her flow to "See table X" located on another page, or worse still, in an appendix. Tufte (1983, p.181) argues

> Data graphics are paragraphs about data and should be treated as such....Imagine if graphics were replaced by paragraphs of words and those paragraphs scattered over the pages out of sequence with the rest of the text—that is how graphical and tabular information is now treated in the layout of many published pages.

While in some cases extensive appendices of data may be appropriate, pull out key data referred to in the text and place these data abstracts directly in the textual flow. Unessential supporting data should either be appended or, in reports developed for wide distribution, omitted altogether.

Writing is an art and skill that improves with practice. Make a habit of writing up short technical memos or research briefs to capture the insights of small data requests. A few

words of interpretation can avoid misuse of data by others. As they accumulate, you build an office reference library helpful in responding to future requests. Many offices have developed report classification and numbering schemes to organize their written publications. For example, report EA94-2 might mean the second enrollment analysis published in fiscal year 1994. The publications typology might include reports to the Board of Trustees (BT), planning briefs (PB), enrollment analyses (EA), market analyses (MA), program evaluations (PE), needs assessments (NA), research briefs (RB), and technical memoranda (TM). The last category of tech memos might include documentation of office methodologies, data compilations without textual interpretation, responses to ad hoc data inquiries, and other analyses not intended for wide distribution. Chartbooks of slides and transparencies prepared for oral presentations might also be included.

Finally, consider preparing reports for publication in the professional literature. As Ruggiero, et al., (1985) argued, "If we don't write – more and better – to each other, many of us are likely to remain number crunchers and file makers – discovering, but failing to interpret and communicate." Writing for external audiences encourages contextual and comparative analyses, plus thoroughness and clarity in exposition. We can learn from each other if we take the time to share our best ideas.

In addition to writing well, effective institutional researchers also have good oral communications skills. The basic principles of good speech communication apply to the oral presentation of data and research findings. The presentation should have a structure, starting with an introduction to catch attention, orient the audience to the subject, and establish rapport. The purpose of the presentation should be clearly established. The body of the speech should contain transitional statements to promote a smooth, logical flow. The presentation should conclude with a brief summary and a strong final point. To overcome shyness, focus on your message and think of public speaking as simply an enlarged conversation. Vary your pitch and intensity to emphasize what is important. Use a few visual aids for emphasis, not a lot as a crutch. Come early to check any equipment you plan to use so as to avoid technical problems.

Electronic dissemination of research findings represents a new frontier for institutional reseearchers. While networks have been used for data sharing and informal inquiries for years, their effective use for disseminating analytical findings is in its infancy. (An exception is on-line access to the ERIC database.) Electronic newsletters and discussion lists serving institutional researchers are increasing, but the first IR electronic journal has yet to appear. Dissemination of institutional research studies through campus networks is also an idea worthy of consideration.

How research findings are shared largely determines how effective they are in influencing decisionmaking. Institutional researchers should carefully evaluate how well they perform the data-to-information transformation. It is hoped that the ideas presented here can serve to stimulate such self-examination, with the goal of improving the effectiveness of the institutional research professional.

Conclusion

The contribution that institutional research can make to a college or university depends upon the practitioner's understanding of the challenges facing the institution and its decisionmakers . We have stressed the importance of knowing the context in which an institution operates, and the culture of its campus. Specific suggestions for improving the productivity of the research office have been offered. Techniques for the effective communication of research findings have been described. However, no one or two of these areas of knowledge is sufficient for ensuring an institutional researcher's influence and effectiveness. We must strive to maximize our expertise in each of these areas in order to make a significant difference at our institutions.

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